

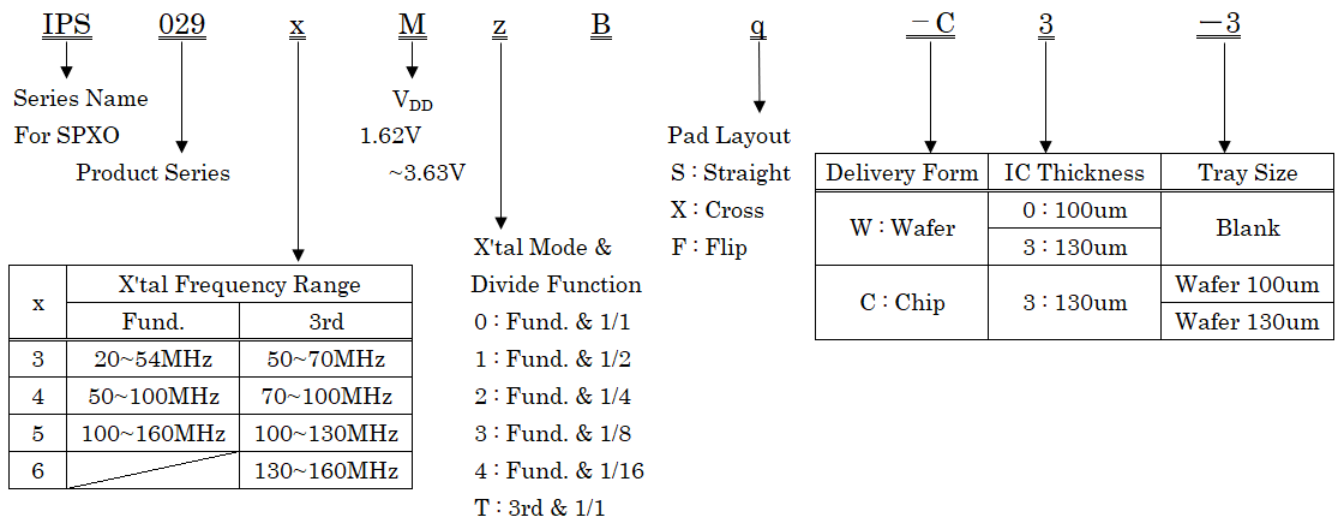
## ■ Description

IPS029\*B series is the successor IC of IPS009BM series and IPS029xM series, for SPXO corresponding to the fundamental or 3rd overtone crystal from 20MHz to 160MHz. Chip size of this IC is small enough for 2016 size SMD. In addition, operation temperature is quite high (125°C) so IPS029xB can be used for various applications.

## ■ Features

- Operation temperature : -40°C~125°C
- Power supply voltage : 1.62V~3.63V
- Standby function : Oscillation stop
- Frequency range : 20MHz~160MHz
- Output : CMOS
- Crystal mode : Fundamental & 3rd overtone
- Small chip size : 0.56mm × 0.56mm
- Divider function : 1/2, 1/4, 1/8 and 1/16
- Duty cycle : Within 50%±5% (Except IPS0295MTBq & IPS0296MTBq)

### 1. Part number rule



## 2. Series

Part Number	Crystal Frequency f (MHz)		Crystal Mode	Divide	Output Frequency F0 (MHz)		Remarks
	Min.	Max.			Min.	Max.	
IPS029 3 M 0 B q	20.00	54.00	Fund	1/1	20.00	54.00	
IPS029 3 M 1 B q				1/2	10.00	27.00	
IPS029 3 M 2 B q				1/4	5.00	13.50	
IPS029 3 M 3 B q				1/8	2.50	6.75	
IPS029 3 M 4 B q				1/16	1.25	3.38	
IPS029 4 M 0 B q	50.00	100.00	3rd	1/1	50.00	100.00	
IPS029 5 M 0 B q	100.00	160.00		1/1	100.00	160.00	
IPS029 3 M T B q	50.00	70.00		1/1	50.00	70.00	
IPS029 4 M T B q	70.00	100.00		1/1	70.00	100.00	
IPS029 5 M T B q	100.00	130.00		1/1	100.00	130.00	
IPS029 6 M T B q	130.00	160.00		1/1	130.00	160.00	

Pad layout q= S : Straight / X : Cross / F : Flip

## 3. Absolute Maximum Ratings

$V_{SS}=0V, T_a=25^{\circ}C \pm 2^{\circ}C$

Parameter	Symbol	Condition	Ratings		
			Min	Max	Unit
Supply Voltage	$V_{DD}$		$V_{SS}-0.5$	5.0	V
Input Voltage	$V_{IN}$	All Input Pin	$V_{SS}-0.5$	$V_{DD}+0.5$	V
Output Voltage	$V_{OUT}$		$V_{SS}-0.5$	$V_{DD}+0.5$	V
Output Current	$I_{OUT}$			25	mA
Junction Temperature	$T_j$		-55	150	$^{\circ}C$
Storage Temperature	$T_{stg}$		-55	125	$^{\circ}C$

## 4. Recommended Operating Condition

$V_{SS}=0V, T_a=-40^{\circ}C \sim 125^{\circ}C$

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
Supply Voltage	$V_{DD}$		1.62		3.63	V	$V_{DD}$
“H” Input Voltage	$V_{IH}$		$V_{DD} \times 0.8$			V	CE
“L” Input Voltage	$V_{IL}$				$V_{DD} \times 0.2$	V	CE
Input Voltage	$V_{IN}$		$V_{SS}$		$V_{DD}$	V	CE
Output Load Capacitance	CL	CMOS			15	pF	OUT
Ambient Temperature	$T_{opt}$		-40		125	$^{\circ}C$	

This IC has enough immunity against ESD and Latch-up, but handle with care.

**5. Electrical Specification**
**5-1 Fundamental**

 Unless otherwise stated,  $CL=15pF$ ,  $V_{DD}=1.62V\sim 3.63V$ ,  $V_{SS}=0V$ ,  $T_a=-40^{\circ}C\sim 125^{\circ}C$ 

Parameter	Symbol	Condition	Specification			Unit	
			Min	Typ	Max		
Output leak current	$I_z$	$CE=0V$ , $X1=V_{DD}$ or $V_{SS}$ $V_{out}=V_{SS}\sim V_{DD}$			10	$\mu A$	
“H” output voltage	$V_{OH}$	$I_{OH}=1.0mA$	$0.9V_{DD}$			V	
“L” output voltage	$V_{OL}$	$I_{OL}=1.0mA$			$0.1V_{DD}$	V	
Output Disable Time	$T_{plz}$				100	ns	
Output Enable Time	$T_{pzl}$				2.0	ms	
Oscillation start up time	$T_{start}$	$V_{DD}\geq 1.62V$			2.0	ms	
Current consumption * $CL=15pF$	$I_{DD}$	IPS0293MxB, $f=27MHz$ , $V_{DD}=1.8V$			2.3	mA	
		IPS0293MxB, $f=27MHz$ , $V_{DD}=3.3V$			4.2		
		IPS0294M0B, $f=100MHz$ , $V_{DD}=1.8V$			6.0		
		IPS0294M0B, $f=100MHz$ , $V_{DD}=3.3V$			12.0		
		IPS0295M0B, $f=150MHz$ , $V_{DD}=1.8V$			14.0		
		IPS0295M0B, $f=150MHz$ , $V_{DD}=3.3V$			20.0		
Current consumption at oscillation stop	$I_{DDD}$	$V_{DD}=3.3V$ , $CE\leq 0.3V$			5.0	$\mu A$	
Freq. $V_{DD}$ deviation	$F_{vst}$	$V_{DD}=1.8V\pm 10\%$	IPS0293MyB IPS0294M0B			$\pm 1.0$	ppm
			IPS0295M0B			$\pm 3.0$	
		$V_{DD}=3.3V\pm 10\%$	IPS0293MyB IPS0294M0B			$\pm 1.0$	
			IPS0295M0B			$\pm 2.0$	
Output Duty Ratio	DUTY	$1/2V_{DD}$ point	45		55	%	
Rise time / Fall time * $CL=15pF$	$T_r / T_f$	$V_{DD}=1.62V\sim 2.25V$ $10\%\sim 90\%V_{DD}$	IPS0293MyB			6.5	ns
			IPS0294M0B			5.0	
			IPS0295M0B			3.5	
		$V_{DD}=2.25V\sim 3.63V$ $10\%\sim 90\%V_{DD}$	IPS0293MyB			4.0	
			IPS0294M0B			3.0	
			IPS0295M0B			2.0	

**5-3 3rd Overtone**

 Unless otherwise stated,  $CL=15pF$ ,  $V_{DD}=1.62V\sim 3.63V$ ,  $V_{SS}=0V$ ,  $T_a=-40^{\circ}C\sim 125^{\circ}C$ 

Parameter	Symbol	Condition	Specification			Unit	
			Min	Typ	Max		
Output leak current	$I_Z$	$CE=0V$ , $X1=V_{DD}$ or $V_{SS}$ $V_{out}=V_{SS}\sim V_{DD}$			10	$\mu A$	
“H” output voltage	$V_{OH}$	$I_{OH}=-1.0mA$	$0.9V_{DD}$			V	
“L” output voltage	$V_{OL}$	$I_{OL}=1.0mA$			$0.1V_{DD}$	V	
Output Disable Time	$T_{plz}$				100	ns	
Output Enable Time	$T_{pzl}$				10.0	ms	
Oscillation start up time	$T_{start}$	$V_{DD}\geq 1.62V$			10.0	ms	
Current consumption * $CL=15pF$	$I_{DD}$	IPS0293MTB, $f=65MHz$ , $V_{DD}=1.8V$			13.5	mA	
		IPS0293MTB, $f=65MHz$ , $V_{DD}=3.3V$			30.0		
		IPS0294MTB, $f=100MHz$ , $V_{DD}=1.8V$			15.0		
		IPS0294MTB, $f=100MHz$ , $V_{DD}=3.3V$			32.5		
		IPS0295MTB, $f=130MHz$ , $V_{DD}=1.8V$			19.0		
		IPS0295MTB, $f=130MHz$ , $V_{DD}=3.3V$			40.0		
		IPS0296MTB, $f=160MHz$ , $V_{DD}=1.8V$			24.5		
IPS0296MTB, $f=160MHz$ , $V_{DD}=3.3V$			47.0				
Current consumption at oscillation stop	$I_{DDD}$	$V_{DD}=3.3V$ , $CE\leq 0.3V$			5.0	$\mu A$	
Freq. $V_{DD}$ deviation	$F_{vst}$	$V_{DD}=1.8V\pm 10\%$	IPS0293MTB IPS0294MTB			$\pm 1.0$	ppm
			IPS0295MTB IPS0296MTB			$\pm 2.0$	
		$V_{DD}=3.3V\pm 10\%$	All Models			$\pm 1.0$	
Output Duty Ratio	DUTY	1/2 $V_{DD}$ point -40 $^{\circ}C\sim 125^{\circ}C$	IPS0293MTB IPS0294MTB	45		55	%
		1/2 $V_{DD}$ point -40 $^{\circ}C\sim 85^{\circ}C$	IPS0295MTB IPS0296MTB	45		55	
		1/2 $V_{DD}$ point 85 $^{\circ}C\sim 125^{\circ}C$	IPS0295MTB IPS0296MTB	40		60	
Rise time / Fall time * $CL=15pF$	$T_r / T_f$	$V_{DD}=1.62V\sim 2.25V$ 10%~90% $V_{DD}$	IPS0293MTB			6.5	ns
			IPS0294MTB			5.0	
			IPS0295MTB			3.5	
			IPS0296MTB			3.5	
		$V_{DD}=2.25V\sim 3.63V$ 10%~90% $V_{DD}$	IPS0293MTB			4.0	
			IPS0294MTB			3.0	
			IPS0295MTB			2.0	
IPS0296MTB			2.0				

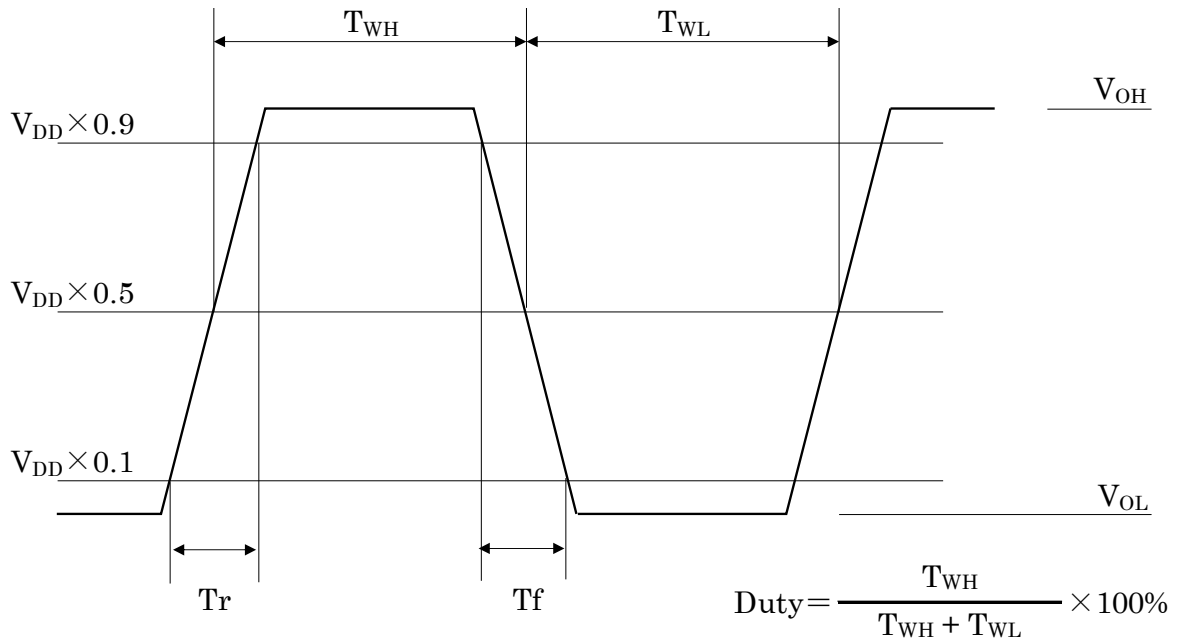
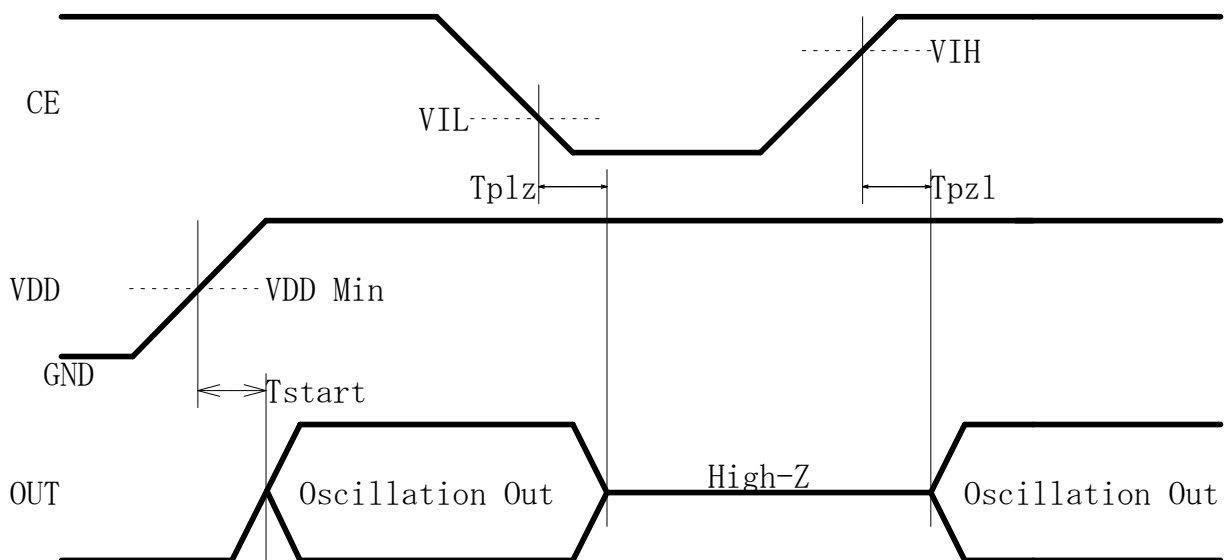


Fig. 5-1 Output Wave Form (Duty, Tr, Tf, VOH, VOL)



$V_{IH}$  : Threshold voltage for Oscillation Start  
 $V_{IL}$  : Threshold voltage for Oscillation Stop

Fig. 5-2 Input output signal timing

**6. Circuit Parameters of Oscillator (Reference Data for Circuit Design)**  
**6-1 Fundamental**

Ta=25°C

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	All Models	Rf	Refer to Fig. 6-1		300		kΩ
Driving Resistor	IPS0293MyB (y=0, 1, 2, 3, 4)	Rd	Refer to Fig. 6-1		1000		Ω
	IPS0294M0B				750		
	IPS0295M0B				250		
Oscillation Capacitor	IPS0293MyB (y=0, 1, 2, 3, 4)	Cg	Refer to Fig. 6-1		5.0		pF
		Cd			12.0		
	IPS0294M0B	Cg			4.0		
		Cd			7.0		
	IPS0295M0B	Cg			4.0		
		Cd			6.0		

**6-2 3rd Overtone**

Ta=25°C

Parameter		Symbol	Condition	Min	Typ	Max	Unit
Feedback Resistor	IPS0293MTB	Rf	Refer to Fig. 6-1		4.0		kΩ
	IPS0294MTB				3.0		
	IPS0295MTB				2.5		
	IPS0296MTB				1.96		
Driving Resistor	IPS0293MTB	Rd	Refer to Fig. 6-1		500		Ω
	IPS0294MTB				250		
	IPS0295MTB				250		
	IPS0296MTB				125		
Oscillation Capacitor	IPS0293MTB	Cg	Refer to Fig. 6-1		10.0		pF
		Cd			5.0		
	IPS0294MTB	Cg			9.0		
		Cd			4.0		
	IPS0295MTB	Cg			8.0		
		Cd			3.0		
	IPS0296MTB	Cg			8.0		
		Cd			6.0		

\*The above values are the design values and are not guaranteed by test.

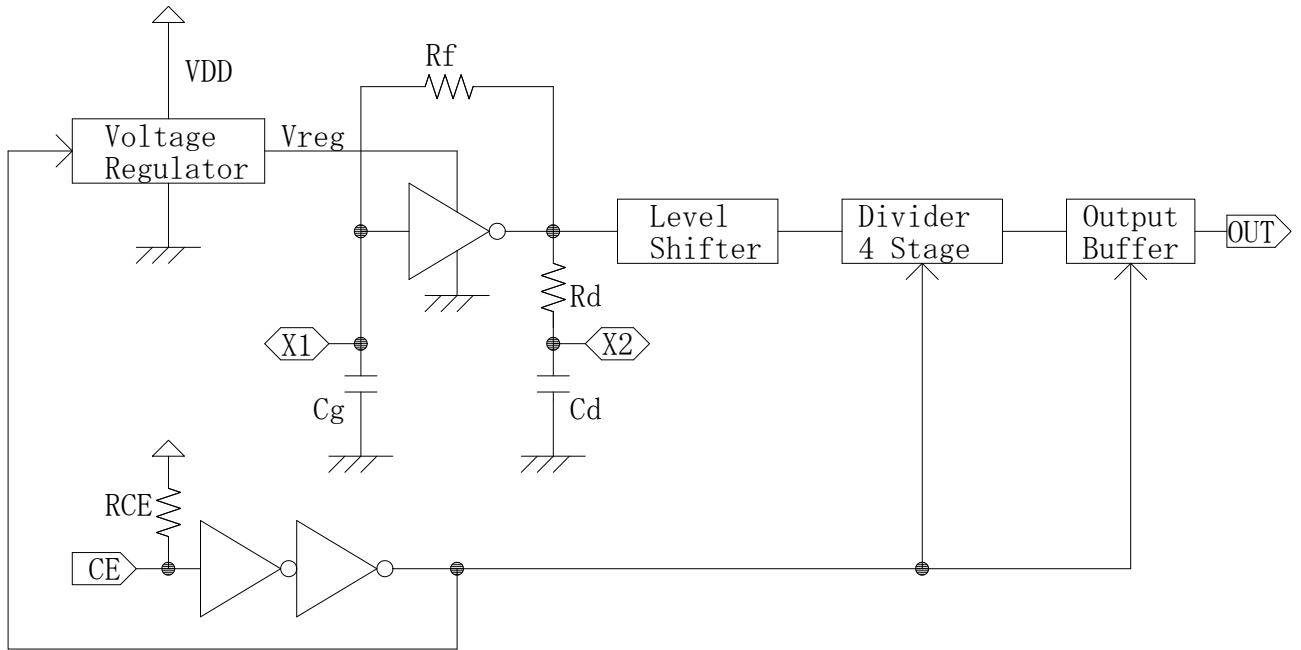
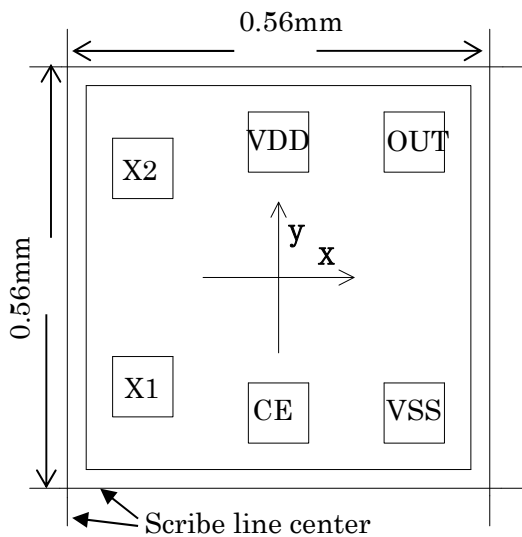


Fig. 6-1 Block Diagram

## 7. Pad Layout

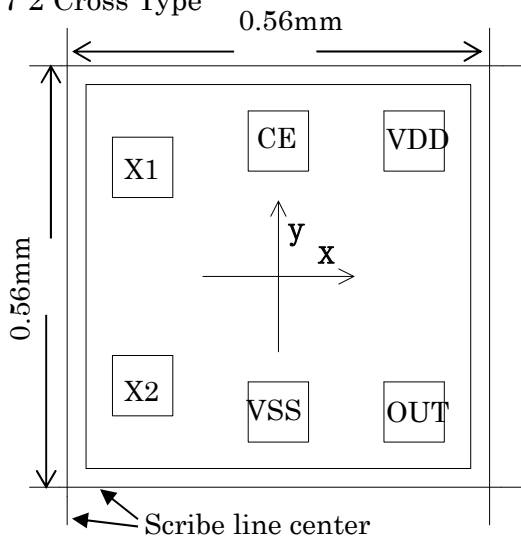
### 7-1 Straight Type



Pad Name	Function	Location (μm)	
		x	y
X1	Crystal Feedback	-181.00	-143.15
CE	Oscillation stop "L": High-Impedance	0.00	-180.55
VSS	(-) Ground	181.00	-180.55
OUT(Q)	Frequency Output	181.00	180.55
VDD	(+) Power Supply	0.00	180.55
X2	Crystal Drive	-181.00	143.15
Chip Center		0	0

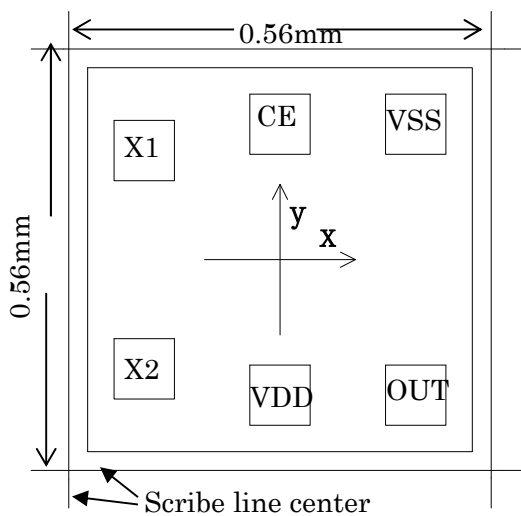
- Die Size: 0.56mm × 0.56mm
- Pad Size: 80um □
- Thickness: 100um or 130um±10um
- IC Backside: Gnd or Open

Fig. 7-1 Pad Layout of Straight Type

**7-2 Cross Type**


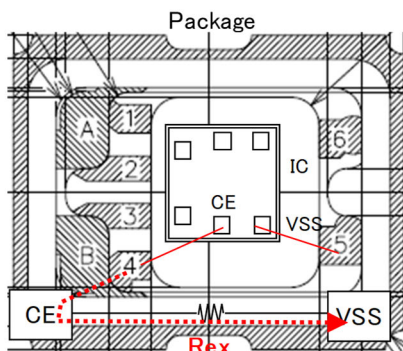
Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-181.00	-143.15
VSS	(-) Ground	0.00	-180.55
OUT(Q)	Frequency Output	181.00	-180.55
VDD	(+) Power Supply	181.00	180.55
CE	Oscillation stop "L": High-Impedance	0.00	180.55
X1	Crystal Feedback	-181.00	143.15
Chip Center		0	0

- Die Size: 0.56mm × 0.56mm
- Pad Size: 80um □
- Thickness: 100um or 130um±10um
- IC Backside: Gnd or Open

**Fig. 7-2 Pad Layout of Cross Type**
**7-3 Flip Type**


Pad Name	Function	Location (μm)	
		x	y
X2	Crystal Drive	-181.00	-143.15
VDD	(+) Power Supply	0.00	-180.55
OUT(Q)	Frequency Output	181.00	-180.55
VSS	(-) Ground	181.00	180.55
CE	Oscillation stop "L": High-Impedance	0.00	180.55
X1	Crystal Feedback	-181.00	143.15
Chip Center		0	0

- Die Size: 0.56mm × 0.56mm
- Pad Size: 80um □
- Thickness: 100um or 130um±10um
- IC Backside: Gnd or Open

**Fig. 7-3 Pad Layout of Flip Type**

**IMPORTANT Notice for CE function**

- ※ Oscillation will not be activated when CE=Open after CE=Low if Rex is not large.
- ※ Reference value of Rex is over 10MΩ with CE=Open usage.
- ※ There is no such issue with CE=VDD usage.

Rex : Resistance value between CE and VSS of package